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ENVIRONMENTAL EVALUATION OF SNOQUALMIE NATIONAL FOREST RESOURCE MANAGEMENT PROGRAMS

Eldon H. Edmundson

Environmental Protection Agency
Seattle, Washington

March 1973

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SNOQUALMIE NATIONAL FOREST RESOURCE MANAGEMENT PROGRAMS

Prepared By

Eldon H. Edmundson

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INTRODUCTION

This report presents the findings of a field study to assess the environmental impacts of resource management activities on the Snoqualmie National Forest. The study was conducted to (a) gain a better understanding of the problems associated with overall resource management, (b) identify specific areas where degradation occurs as a result of such management, and (c) to develop procedures for minimizing or preventing such degradation.

This activity is a part of the Environmental Protection Agency's current program to assist the Federal agencies in meeting their environmental responsibilities. The conclusions and recommendations, while specific to the Snoqualmie National Forest, could also apply to other Forest Service areas having similar activities and problems.

The Snoqualmie Forest is managed for recreation, timber production, water supply, wildlife, grazing, and mining purposes. Problems associated with these activities are often concentrated into specific geographical areas, such as ski resorts, campgrounds, and clearcuts.

Effects of these activities on air and water quality were evaluated during the field studies. In addition, programs for public water supply protection, solid wastes management, pesticides use, and oil and hazardous materials handling and storage were examined.

Approximately five weeks were spent on the forest. In this time frame, it was not possible to conduct an in-depth analysis of all activities, but merely to identify major problems and obtain an indication of the impacts from the various operations. Information was obtained through discussions with Snoqualmie National Forest personnel in the supervisor's office and on the ranger districts. Field inspections were also conducted with and without Snoqualmie National Forest personnel.

The cooperation and assistance of Mr. Donald Campbell, Forest Supervisor, and the entire Forest staff was greatly appreciated. This study would not have been possible without the cooperation and constructive attitudes of the Forest Service personnel.

RECOMMENDATIONS

The following recommendations are presented according to priority of overall environmental control so that their relative importance will be indicative to managers responsible for allocating limited resources. It should be stressed that only the more significant control measures have been addressed in these recommendations and that all are essential to an effective environmental control program. The recommendations were developed in full recognition of the budgetary and manpower resource limitations of the Forest Service.

General

1. Strengthen coordination with State agencies regarding application and enforcement of environmental law and regulations. One means of accomplishing this is through reaffirming existing working agreements and development of new agreements as necessary to clearly define responsibilities and planned actions of all concerned parties.

2. Improve compliance with the National Environmental Policy Act. Special attention should be given to improving methods for predicting the environmental impacts of proposed resource management activities and for developing alternative management plans to allow public choices and opportunity for expressing their choices.

3. Establish a Forest-wide air and water monitoring program with the State of Washington, counties, U.S. Geological Survey and

EPA compatible with the regional monitoring program coordinated by EPA. The program should be designed to detect standards violations associated with ongoing resource management activities, to document baseline quality, and establish long-term trends or changes in the quality.

4. Refine procedures to ensure licensees, grantees, contractors and special use permittees comply with applicable environmental standards and regulations.

Recreation

1. Water Supply - Strengthen water supply monitoring, inspection, reporting and enforcement programs for Forest Service and special use permit facilities. Specific actions suggested should include:

a. Transfer control for Forest Service water supplies from districts to the Supervisor's office to a qualified water supply specialist. The specialist's duties may include:

(1) Ensuring that samples are collected in accordance with the Forest Service Manual.

(2) Follow-up action on any unsatisfactory sample.

(3) Initiating a chemical data base covering all campground water supplies. Developing a chemical sampling program where the maximum time between samples is three years.

(4) Conducting annual and follow-up sanitary surveys on all drinking water systems including those found unsatisfactory

during ongoing operations.

(5) Ensuring that county and State regulations involving drinking water systems on special use permit areas are enforced.

b. Conduct periodic training sessions for all employees involved with water supplies.

2. Sanitary Wastes - Strengthen sewage disposal inspection, monitoring, reporting and enforcement program for Forest Service and special use permit facilities. Specific actions should include:

a. Review a portion of the treatment facilities at special use permit areas yearly.

b. Provide facilities for receiving sewage from self-contained travel trailers and campers.

c. Move pit toilets which periodically fill with ground water, or change them to sealed vaults.

3. Solid Waste - Implement procedures for handling solid wastes from winter recreation areas during heavy peak as well as normal day use.

Natural Resources

1. Timber - Many of the following recommendations are also found in the U. S. Forest Service publication, National Forest in a Quality Environment Action Plan. Ensure that presently

unquantified environmental values are given appropriate consideration in decision making along with economic and technical considerations. Specific actions which can be used in reducing degradation from timber management activities are:

a. Continue to write impact statements on multiple use plans. Improve predictions in the planning phase, of the effects from individual actions. For example, on a timber sale, include whether these activities will adhere to water or air quality standards. If deviations are expected, list them and the duration of such deviations. Also, continue to prepare environmental analysis reports through public involvement. Write impact statements on those specific projects significantly affecting the environment.

b. Establish a program to monitor water and air quality affected by logging to ensure compliance with Federal, State and local air and water pollution laws and regulations and for comparison with predicted effects mentioned in paragraph a. above.

c. Determine level of regular field inspection of logging and road building operations necessary to ensure compliance with environmental standards. Defer those operations that cannot be provided a proper level of administration.

d. Strengthen contract language to allow an effective means of penalizing timber sale contract violations.

e. In areas where road locations are questionable from environmental impact standpoint, use logging methods not requir-

ing new roads or refrain from logging that area.

f. Ensure that restoration of logged areas is adequate. If timber sale funds are not adequate for restoration work, do not log that area.

Special Environmental Problems

1. Pesticides - Strengthen inspection, monitoring, reporting, and enforcement programs for storage, application, and disposal of pesticides used by Forest Service, licensees, grantees, contractors, and special use permittees. Specific suggestions are:

a. Prepare impact statements on individual pesticide application projects, particularly conifer release programs, rights-of-way spraying, and range revegetation which may cause a significant impact on the environment.

b. Require licensees, grantees, contractors, and special use permittees to identify methods and locations for disposing of pesticide residues and containers. Approve only those permits where the methods and locations are acceptable.

c. Continue to store hazardous pesticides in sealed containers until acceptable disposal methods are identified.

2. Municipal Watersheds - Identify watersheds used for municipal or private drinking water supplies on maps for public distribution. Identify and publicize uses or activities prohibited or restricted in these drinking water supply watersheds, and restrict uses accordingly.

3. Oil and Hazardous Materials

a. Develop contingency plans for use at the district level.

b. Conduct training sessions for people transporting oil and hazardous materials through Snoqualmie National Forest lands.

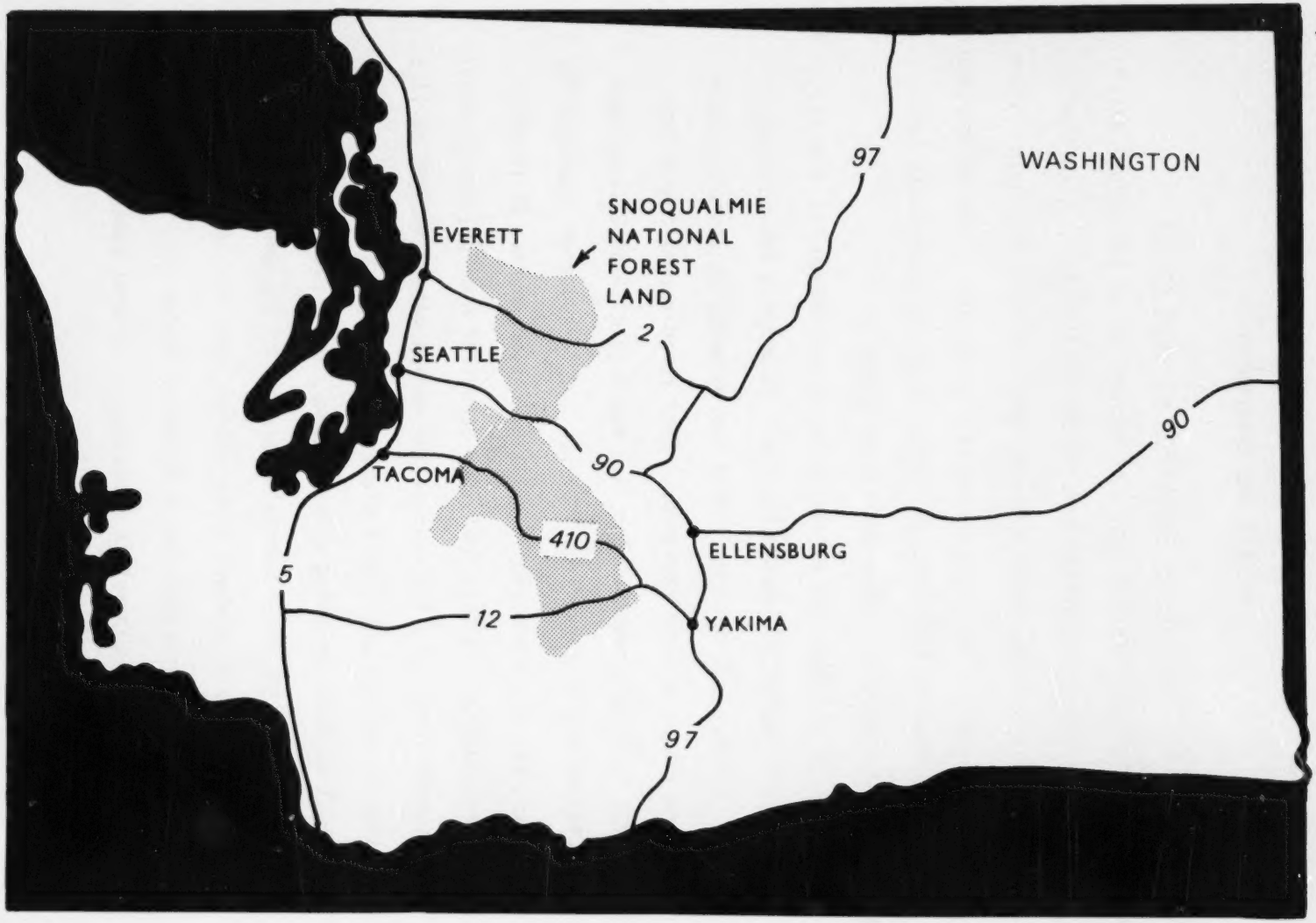
RESULTS AND DISCUSSION

Study Area - Snoqualmie National Forest

Snoqualmie National Forest is located 48 km (30 miles) east of the largest metropolitan area in the Pacific Northwest, the Seattle-Tacoma area, which includes some 1.5 million people (See Map). Snoqualmie National Forest also encompasses some of the Douglas fir and ponderosa pine forests, which supply wood products to a large and important timber processing industry.

During the past few years, an increased demand has also occurred on the forest for recreation use. To protect recreational areas, greater citizen involvement has occurred in deciding where and how timber will be harvested. Year round recreation at Snoqualmie National Forest during 1971 was 3.23 million visitor days. (A visitor day is considered 1 person for 12 hours or 2 persons for 6 hours, etc.). These people utilize 78 campgrounds, 12 resorts, 400 organizational sites (YMCA, Boy Scouts of America, etc.), about 850 summer homes, and the rest of the approximately 460,000 ha (1.5 million acres) present. This places a tremendous strain on sewage disposal systems, drinking water systems, solid waste collection systems and on the environmental character of the area.

In the case of timber, these changes have resulted both in reduced amounts harvested and in different harvesting techniques. New or different equipment is necessary to harvest timber in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ELLENSBURG
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YAKIMA
97

accordance with required methods. Improved timber harvesting methods can be expected to increase costs, making small volume operations marginal. This has, in many cases, caused the timber industry to apply pressure to increase the amount of timber allowed to be cut.

Snoqualmie National Forest is also used for municipal or private water supplies. Presently, there are 10 municipalities, 8 special use permittees and 850 summer homes utilizing more than 41,000 ha (100,000 acres) of forest watersheds as a source of drinking water supplies. In order to meet the Public Health Service drinking water standards and established criteria for watershed activity, the Forest Service provides strict control over these areas.

The resource manager on the forest is faced with many decisions and is pressured by many different groups. To ensure that proper environmental considerations have been taken to comply with the recent environmental laws, greater care must be taken to plan what is the best land use and how the activity within that area should be carried out.

The above examples are just a few of the potential conflicts in land use that the Forest Resource Manager faces. He must carry out his function, satisfying as many of these demands as possible, and still comply with the applicable environmental Executive Orders and laws.

During this study, environmental problems from forest activities were separated into three main types: Recreation, Natural Resource Utilization, and Special Environmental Problems.

Recreation

Recreation covers activities at the Forest Service campgrounds and at special use permit organizational camps, summer homes and winter and summer resorts. Occurring at these sites are major problems with drinking water supply and inadequate sanitary waste disposal and a minor problem of inadequate solid waste disposal. Various executive orders and laws state that Forest Service activities must comply with Federal, State and local laws. Also, the Forest Service Manual states explicitly that all special use permittees must also comply with Federal, State and county regulations. This general requirement is included as a condition of the permits or leases.

Drinking Water

Provision of the safe drinking water at developed recreation areas is a primary responsibility of the resource management agency. In carrying out this responsibility, the U.S. Forest Service has developed policy statements and operating criteria for both administrative and field operations.

This review of the water supply aspects of Snoqualmie National Forest operation, therefore, focused on two areas: 1) adequacy of policy statements and operating criteria and 2) compliance of field operations with established criteria.

U.S. Forest Service Manual Title 5600 - Engineering, Paragraph 5652 - Water and Sanitation Systems, describes the policy, responsibilities, and general criteria for water supplies under agency jurisdiction. Water supply directives are also contained in other Titles such as Title 2300 - Recreation Management. Each of these titles was reviewed to determine the adequacy of Forest Service policy and directives with respect to current public health management practices. The following areas are considered to have the most significant impact on Forest Service water supply operations.

The water supply objective, as set forth in 5652.02, is to ensure a safe, adequate water supply as well as a sanitary environment at all administrative sites and public use areas. Policy statements include those of prohibiting the use of drinking water systems utilizing untreated surface water. The policy continues by requiring that known contaminated lakes and streams in developed areas be conspicuously posted, "Water Unsafe to Drink." Review of facilities and field observations indicate that not all permittee water supplies utilizing surface sources are adequately treated (Table 1) nor are known contaminated streams in developed areas properly posted.

Forest Service Manual Paragraph 5652.21 requires a sanitary survey of all proposed water supply sources to determine potential for pollution. Analyses for physical, chemical and bacteriological

TABLE 1

WATER SUPPLY AND WASTE DISPOSAL AT SPECIAL USE PERMIT RECREATIONAL AREAS

PERMITTEE	WATER SUPPLY	TREATMENT	WASTE DISPOSAL
Alpental Ski Area	Open Stream	Chlorination	Septic Tank & Drainfield
Alta Silva	Open Stream	Chlorination	Septic Tank & Drainfield
Bumping Lake	Open Stream	Chlorination	Septic Tank & Drainfield
Chris's Cove	Springs	Chlorination	Septic Tank & Drainfield
Crystal Mt. Ski Area	Open Stream	Chlorination	Septic Tank & Drainfield
Kunz's Resort	Open Stream	Chlorination	Septic Tank & Drainfield
Rimrock Landing	Open Stream	Chlorination	Septic Tank & Drainfield
Silver Beach	Open Stream	Chlorination	Septic Tank & Drainfield
Snoqualmie Summit Ski Area	Open Stream	Chlorination	Hyak Lagoon System
Stevens Pass	Open Stream	Chlorination	Septic Tank & Drainfield
White Pass	Sealed Springs	No Chlorination	Septic Tank & Drainfield

quality are also required to ensure conformance of water quality with the PHS Drinking Water Standards. A review of Snoqualmie National Forest office records shows that surveys are conducted and samples are collected. Chemical analyses, however, are not run on the complete set of quality criteria in the Drinking Water Standards. In most cases, no analyses are provided for the mandatory constituents such as lead, silver, cadmium, etc. From the standpoint of public health, these mandatory limit constituents are the most critical; yet data are completely lacking.

Sampling programs for quality control are a critical aspect of any operation and maintenance program. Paragraph 5652.41 describes the bacteriological sampling program for agency water supplies. No mention is made, however, of routine sampling for chemicals - a definite inadequacy. There appears to be some question also of the adequacy of bacteriological sampling program described in Paragraph 5652.41. The manual states that the frequency, which is based on visitor use days and the system's prior sampling record, was worked out with the Public Health Service. The frequency appears inadequate, however, particularly in view of the type of recreational supply normally encountered. In Snoqualmie National Forest for example, the majority of the supplies are surface sources with simple chlorination or shallow wells in alluvial material. As an example, a small campground supply with a previously good record would be sampled once prior to opening

of the system for the season and then only once again during the operating season. Having observed a representative number of Forest Service water systems, it appears that this sampling frequency, or even once per month sampling, will not detect the unusual circumstances that a statistical sampling procedure such as that included in the Drinking Water Standards is designed to detect. It appears that the bacteriological sampling frequencies need revision. Title 5600 - Engineering is apparently being revised with water supply being retitled 7420. It would appear that the entire Paragraph 7420 should be reviewed by EPA for adequacy with respect to public health.

Sampling programs, particularly those for bacteriological determinations, have limited value if not accompanied by current sanitary survey information. Paragraph 5652.42 requires documented condition surveys of all water supply and distribution systems by a technically qualified inspector at least once per year. A review of Snoqualmie National Forest operations indicates that such surveys are not being accomplished. The significance of Snoqualmie National Forest bacteriological data currently being collected, therefore, is questioned. In this regard a spot check was made of a bacteriological sampling program within a Snoqualmie National Forest district. This survey indicated that in some cases bacteriological samples are not being collected even in accordance with the present frequency schedule.

Eighteen campgrounds have developed drinking water supplies consisting of either handpumps or pressure systems. The others have no developed water supply and the public either brings their own water or utilizes nearby streams.

As a check on the adequacy of water supplies provided by Snoqualmie National Forest, a survey of facilities operated by Naches and Tieton Ranger Districts was conducted on August 22-23, 1972. Both handpump and piped pressure systems were observed. In general, the water supply facilities were acceptable from the standpoint of proximity to potential contamination. Care must be taken in location of pit toilets as many of the wells are shallow with water being drawn from unconfined water-bearing strata at depths as shallow as 9.1 m (30 ft.). Specifics of facilities surveyed and deficiencies noted are included in the Appendix.

In general, all handpump installations were of relatively recent construction and, except for repairs of a few seals at the base of the pump casing, were maintained satisfactorily. The older piped systems exhibited need for more maintenance as shown by system deficiencies described in the Appendix. For example, oil leaking from a feed pump had contaminated the chemical feed day tank used as part of the iron and manganese removal system at Hause Creek Well #2. A rat's nest and excreta were also noted on top of the potassium permangenate tank. Access holes through the tank cover for the feed lines provided the potential for contamin-

ation of the solution with animal excreta. Although hopefully an extreme, this example illustrates the need for additional surveillance of facilities and adequate maintenance to prevent contamination of the water supplies.

Bacteriological samples were taken from each of the systems surveyed. Samples were taken to the State Department of Social and Health Services laboratory in Seattle for analysis. One sample, that from the handpump in the Wild Rose Campground, was reported as unsatisfactory.

As mentioned, a review was also made of the chemical data on hand in the Snoqualmie National Forest office in Seattle. Many of the supplies exceed the Public Health Service recommended limits for iron (0.3 mg/l) and manganese (0.05 mg/l), and no routine chemical sampling program is provided. This is true even of the Hause Creek supply where treatment is provided for iron and manganese control. No trace metal analyses are provided for the supplies. This would appear to be a significant deficiency in view of the fact that exceeding one of the PHS Mandatory Chemical Limits is grounds for rejection of the supply for drinking purposes. In another case, a sample from the American Forks Campground supply was analyzed for zinc with a level of 7.3 mg/l being reported. The recommended level for zinc is 5.0 mg/l.

Snoqualmie National Forest also has 12 developed water supplies associated with special use permit recreation areas.

These consist of wells, open streams with chlorination, and sealed springs without chlorination. A list of these water supplies are given in Table 1. Water samples are taken by the permittee, county or State Health Department, and Forest Service and sent to the county for analysis.

A survey was also made of the water supply at Bumping Lake Resort, a special use permit facility. The operation of this system has inadequate protection at the source, poor maintenance of the transmission facilities, inadequate control of chlorination, insufficient chlorine contact time prior to distribution to the first customer, and questionable distribution system pipe sizing to maintain adequate pressure.

Sanitary Wastes

There are two activities which require some type of sewage disposal system, campgrounds and recreational areas under the special use permit. Presently, all waste is disposed of by either septic tank and drainfield or pit toilets. The Forest Service Manual states that wastes from these activities must be such that waters are protected and Federal, State and local regulations are met.

There are approximately 76 campgrounds having a total of 300 pit toilets on Snoqualmie National Forest. It is known that water leaks into many of these toilets during high water and drains out as the water table drops. Snoqualmie National Forest is now using maintenance funds to convert many of the problem pits to

sealed vaults. On those campgrounds where water supplies were present, pit toilets were inspected for location to water supplies and streams, cleanliness, rodent control, and presence of groundwater in the pit (Table 2). All inspected campgrounds were located on old streambeds, adjacent to the existing streams. The groundwater level is approximately 1.52 m (5 ft) or greater below the pit toilets during the summer recreation period. However, during heavy spring runoff, many pits are filled with groundwater. Pit toilets are pumped annually, but not necessarily at the end of the season. Generally, all pit toilets were clean and only one had an excessive odor problem. At many of the sites, pit toilets were located upstream from drinking water supplies.

There is another problem arising from campground use, that being waste disposal from self-contained travel trailers. The use of this type of recreation vehicle is becoming increasingly popular. However, there are few, if any, locations on Snoqualmie National Forest where the waste from these containers can be satisfactorily disposed. Funds have been requested to develop such facilities but were turned down because of lack of ability to show a pollution problem.

Recreational areas under the special use permit are another activity causing pollution. Presently, the sewage from the 11 resorts, 400 organizational sites (YMCA, Boy Scouts of America, etc.) and around 850 summer homes is disposed of with septic tanks and

TABLE 2

SANITARY SURVEY INSPECTIONS OF SELECTED CAMPGROUNDS IN SNOQUALMIE NATIONAL FOREST

Campgrounds	Water Supply	Pit Toilets					
		Distance From Pit Toilets m (ft)	Odor	Nearness to Streams m (ft)	Types	Rodent Proof	Comments
Cougar Flats	Well & Hand Pump	45 (150)		45 (150)	"	Yes	Possible drainage from pits into low area 6 (20)-7.6 m. (25 ft.) away
Kanen Flat	"	45 (150)	minor to medium	45 (150)	"		Inspected 8 pits; Possible ground-water
Sawmill Flats	"	9 (30) downstream	minor	45 (150)	"	Yes	Possible ground-water in 1 pit
Cottonwood	"	45 (150) downstream	minor	45 (150)	"	Yes	Well located down-stream from
Indian Creek	Pipe & Pressure System	6 (20)	minor	45 (150)	Earth	Yes	
Hause Creek	Hand Pump Wells	45 (150)	minor	45 (150)	Concrete Box Not Waterproof	No	Possible ground-water in 1 pit
Wild Rose	"	45 (150)	none	45 (150)	"	Yes	Freshly cleaned
Willows	"	45 (150)	none	45 (150)	"	Yes	Freshly cleaned
Windy Point	"	45 (150)	none	45 (150)	"	Yes	Freshly cleaned

TABLE 2 (CONTINUED)

	Water Supply			Pit Toilets			
Campgrounds	Type	Distance From Pit Toilets m (ft)	Odor	Nearness to Streams m (ft)	Type	Rodent Proof	Comments
Silver Springs	Well-Pressure System	45 (150)	minor	15 (50)	Concrete Box Not Waterproof	Yes	Potential for erosion to wash these 2 pits away
Silver Springs	"	4.5 (15) & 7.6 (25)	minor	45 (150)	Earth Pit	Yes	
Silver Springs	"	45 (150)	minor	45 (150)	Concrete Box Not Waterproof	Yes	
Hells Crossing		45 (150)	considerable	45 (150)	"	No	No paper
Hells Crossing		45 (150)	minor	15 (50)	"	No	Possible ground water in pit
Hells Crossing	Well & Hand Pump	downstream 15.2 (75) & 30.0 (100)	medium	45 (150)	"	No	Location of pits upstream from well
American Forks	"	45 (150)		45 (150)	"	No	Recently, there were 2 pit toilets 7.6 m (25 ft.) from well

drainfields, or pit toilets. There is little information available on the effects to the aquatic environment of these activities. However, the adequacy of disposal systems at a few resorts is highly questionable. For example, White Pass Ski Area has a dosing type system. According to a State Health Department employee, the switching mechanism for the dosing system does not operate effectively, and for extended periods of time only one side is used. As a result, effluent has seeped into nearby areas. Snoqualmie National Forest has put the permittee on notice that the problem must be corrected. As another example, Crystal Mountain Ski Area, which presently has a septic tank and drainfield, is planning in the future to switch to lagoon. One proposed location for the new facility is near the main highway. A condition exists here where other developments could utilize the system, if planning is done properly. A summer resort, summer homes, Snoqualmie National Forest campgrounds, and Mount Rainier National Park campgrounds are all within service distance of the new location. The Snoqualmie National Forest is urging the other parties to form a total service area to utilize one treatment facility but is having difficulty getting cooperation. There is no information on the problem of sewage disposal from summer homes. While most of the 850 residents use pit toilets, the adequacy in terms of location and seepage has not been documented. However, some substandard disposal systems were pointed out as examples of

what was occurring. The special use permit states that the permittee must comply with State, local and Federal standards.

Solid Waste

Solid waste generated from recreation and administrative activities is disposed at city or county dumps and landfills. In relation to this disposal on non-Forest Service land, the Forest Service Manual 7460.34 states that "land disposal off Forest Service land, of solid waste from forest facilities and activities shall be limited to the following two alternatives:

1. The disposal method is by sanitary landfill.

2. The disposal method is by a "modified" operation regulated by State law with the State regulations being enforced on a continuing basis by local authorities having jurisdiction."

There are no active solid waste disposal sites on Snoqualmie National Forest. However, according to a Snoqualmie National Forest inhouse report, three inactive sites located in the North Bend Ranger District (RD) need cleanup. All solid waste is hauled to off-forest disposal sites. The solid waste hauling contract requires the contractor to comply with State regulations.

The Washington minimum functional standards for solid waste, which became effective on November 24, 1972, specify only sanitary landfills. Over the next few years, there will be a phasing in period for these standards, but modified landfills should not be considered adequate. Snoqualmie National Forest will contract

next year to only those who have landfills meeting Federal requirements. However, it is questionable whether any of the presently used landfills will meet these guidelines. Presently, the Naches and Tieton RDs' wastes are hauled to the Yakima City landfill; Skykomish RD, to Skykomish landfill; North Bend RD, to Cedar Falls County landfill; and White River RD, to Buckley or Tacoma landfill. According to State authorities, the landfills will either be closed or upgraded to meet State standards. It is not known at this time what the time frame will be for either closing or upgrading. It has also been reported that some recreation facilities pile up waste during bad weather and haul it in better conditions. Accumulated wastes were observed this winter on Snoqualmie Summit and at Crystal Mountain Ski Area.

Natural Resource Utilization

Natural resource utilization in Snoqualmie National Forest (SNF) includes a major activity, timber management, and two minor activities, mining and grazing.

Timber

Timber management on National Forests has received much criticism in the last few years. Much of the criticism has been aimed at the way logging has been conducted and the lack of environmental controls to minimize the impacts. Several studies on timber management have been performed, recommending changes which the Forest Service should undertake for reducing the adverse impacts. One of these studies was conducted by a Forest Service team commissioned to review National Forest timber management activities. The report identified thirty problem areas that needed attention. The Forest Service has developed a National Forest in a Quality Environment Action Plan to treat these thirty findings. Included in the plan are, among other things, actions for reducing adverse environmental impacts from timber harvesting and road construction. Adverse impacts from timber activities on SNF should be reduced when these action plans are followed.

The total National Forest land administered by SNF is approximately 471,000 ha (1,150,006 acres). Of this 254,309 ha (620,267 acres) is commercial forest which supports an annual allowable cut of 214.3 million board feet. Timber harvesting is divided into

two working circles, the Snoqualmie (westside) and the Naches-Tieton (eastside). Timber on the westside consists largely of Douglas fir, hemlock and true firs while that on the eastside is ponderosa pine, Douglas fir, and associated species. Predominant silvicultural practices for harvesting on the westside are clear-cutting and preparatory seed, and on the eastside overstory removal and intermediate cut. Estimates of the harvesting, by silvicultural practice during calendar year 1971 are given in Table 3.

Over the whole forest the Snoqualmie working circle contains 60% of commercial forest land and 75% of the total estimated volume. During 1971, the Snoqualmie working circle cut 30% of the total logged acres for that year. Of this, 10% or 676 ha (1,689 acres) of commercial land cut during 1971 produced approximately 50% of the timber. Discussed below are environmental problems resulting from harvesting, pre-commercial thinning, road construction and forest residues. Also present are short discussions on the Forest Service monitoring program to evaluate these impacts of timber management, and on roadless areas in SNF.

Harvesting. Unfortunately, in a study like this, the environmental costs associated with timber harvesting cannot be fully quantified; and it is difficult, therefore, to evaluate whether the activity is resulting in violation of the various environmental laws. Some effects can be identified from field observations; but the long-term, many times more damaging, effects are difficult

TABLE 3

APPROXIMATE ACRES AND VOLUME[1/] CUT BY SILVICULTURAL PRACTICES WITHIN A WORKING CIRCLE BETWEEN JANUARY 1, 1971 AND DECEMBER 31, 1971

Silvicultural Practice	Snoqualmie Working Circle		Naches - Tieton Working Circle		Total	
	ha (acres)	Volume	ha (acres)	Volume	ha (acres)	Volume
Reg. Sanitation & Salvage	149 (364)	1.5	408 (995)	0.7	557 (1359)	2.2
Regulated Clearcut	692 (1689)	87.3	38 (93)	2.1	730 (1782)	89.4
Preparatory Seed	204 (449)	8.8	0 (0)	0	204 (499)	8.8
Overstory Removal	56 (137)	3.5	3066 (7480)	53.7	3122 (7617)	57.2
Intermediate Cut	510 (1244)	3.6	1612 (3932)	4.8	2122 (5176)	8.4
Unregulated	418 (1020)	4.0	0	.3	418 (1020)	4.3
TOTAL	2029 (4953)	108.7	5124 (12500)	61.6	7153 (17453)	170.3

1/ In million board feet and includes unregulated cut

to measure without an extensive monitoring program to document both "before" and "after" conditions.

During this study, examples of past and present timber sales were observed. In past sales, Forest Service employees pointed out improper practices such as logging adjacent to and through streams, excessive slash material left around yarding areas and next to streams, and excessive logging spurs. On a present sale observed in the Cedar River Watershed, there appeared to be proper environmental controls and sale administration to minimize the effects of the logging operation. For example, slash was being piled for burning; barriers were placed in temporary roads to control erosion; and a Forest Service employee inspected the sale daily. However, an ongoing clearcut timber operation in the White River drainage showed evidence of trees fallen across a small stream flowing through the sale area. According to a Forest Service employee, this was the result of an old contract and would have been prevented under the new contract language.

The Forest Service is developing stream side management procedures to aid in reducing the impact of logging. Some of these procedures to help protect streams include: leaving buffer strips along stream sides, prohibiting logging through streams, requiring slash to be removed from streams, and felling trees away from streams. While these requirements will help in reducing the impact, the actual effectiveness of the new contract will depend

on how the Forest Service administers the timber sale. Generally, it is agreed by the Forest Service and others that sale layout and administration has been inadequate in the past. In most cases, this was due to staffing limitations. It is still questionable whether the Forest Service has adequate sale administration. One method of determining whether there are sufficient sale administration and environmental controls on a timber operations is by monitoring the area for changes in water, air, or other environmental quality indicators. Presently, the Forest Service does little, if any, water monitoring of a timber operation to ensure compliance with applicable environmental standards.

Pre-Commercial Thinning. Pre-commercial thinning involves removal of certain trees to allow better growth in the stand. This can be done by applying chemicals directly to individual trees, or by mechanical or manual cutting. One by-product from pre-commercial thinning activity is excessive slash. The associated environmental problems will be discussed under forest residues. SNF has stopped all chemical thinning activity and used mechanical means on only 309 ha (755 acres) during 1971.

Roads. The majority of the roads in a forest are constructed for timber harvesting purposes. However, the number constructed depends on how the timber is harvested and the existing road system. For example, clearcutting usually requires fewer roads than partial cutting because less acreage is required to obtain

a given volume of timber. During FY 72, approximately 129 km (80 miles) of roads were constructed for timber management and only 16 km (10 miles) for non-timber purposes. The majority of these roads were single lane, handling light traffic and included both temporary and permanent system roads. Environmental impacts from road construction involve slash disposal and erosion resulting from drainage changes, culvert and bridge placements and road runoff. The Forest Service Manual mentions repeatedly the concern for protecting the water, soil, fish, aesthetics and recreation values and for meeting the State or Federal environmental standards. For example, the Forest Service Manual 2482.2a on "Measures for Prevention and Control" states that during road construction, "Road cuts should be sloped and graded with careful regard to soil type. Soil stabilization measures such as matting, terracing, compacting, mulching and planting with grass or shrubs should be used as necessary."

To obtain some indication of problems from roads, a survey of roads in the White River and Naches Ranger District was conducted during May, 1972. In general, road placement and design were satisfactory. However, there was a considerable amount of exposed soil, indicating that soil stabilization measures were apparently unsuccessful. One place where excessive erosion was evident occurred on a road built on a steep hillside.

Forest Residues. Forest residues are becoming an increasingly

important problem in National Forest lands. A study conducted by the Forest Service in 1971 found that in the Northwest Douglas fir region, forest residues varied from 70-500 tons/ha (32 to 227tons/acre). The total forest residue amounted to 50% of the wood consumption by the timber industries in western Washington and western Oregon for 1968.

Forest residues must be treated as a usable resource. Considerable amounts of forest residues were generated on SNF. For example, clearcutting on the eastside generates approximately 55-99 tons/ha (25-45 tons/acre), depending on method of piling. During the period from 1968-1971, an average of 130,940' tons (163,279 tons) of residue was burned each year (Table 4) with approximately 85% of it coming from the westside clearcutting. Presently, forest residues are handled by either broadcast burning, machine pile burning, cable yarding, handpile and burning, or chipping. The average cost for fuel treatment on SNF is given in Table 5. In most cases, 100% cleanup of residues and non-organic debris is required.

Disposal by burning is presently conducted under the Washington State Smoke Management Plan. Burning woody materials affects air quality through the emission of hydrocarbons, particulate matter, and carbon monoxide. Because of the broad variety of fuel constituents and burning modes involved, accurate emission inventories for this source of air pollution are difficult to obtain. In turn, the

TABLE 4

HECTARES (ACRES) OF FOREST RESIDUES BURNED DURING 1968-1971 IN SNOQUALMIE NATIONAL FOREST

		Clearcut				Partial Cut			
		Broadcast		Machine Piling		Machine Piling		Hand Piling	
1968	Westside	659	(1607)[1/]	25	(61)	20	(48)	11	(27)
	Eastside					104	(260)	188	(459)
1969	Westside	710	(1732)	11	(27)	30	(74)	2	(5)
	Eastside					235	(575)	383	(932)
1970	Westside	489	(1192)	48	(109)	21	(50)	29	(70)
	Eastside					156	(381)	56	(136)
1971	Westside	148	(363)	35	(85)	143	(351)	6	(15)
	Eastside			60	(147)	595	(1452)	11	(27)
Total	Westside	2,006	(4894)	109	(282)	214	(523)	58	(117)
	Eastside			60	(147)	1,083	(2668)	638	(1554)

1/ average tonnage per ha (ton/acre) is:
198 (90) - Westside clearcut
132 (60) - Eastside clearcut
110 (50) - Westside Partial Cut Machine Piled
99 (45) - Eastside Partial Cut Machine Piled
44 (20) - Westside Partial Cut Hand Piled
55 (25) - Eastside Partial Cut Hand Piled

TABLE 5

AVERAGE COSTS FOR FUEL TREATMENT

Method	Cost (Dollars) for 1 ha	(Cost (Dollars) for for 1 Acre)
Broadcast Burn	156	65
Machine Pile and Burn	112 - 360	80 - 150
Cable Yard (YUM)	720 - 1200	300 - 500
Hand Pile and Burn	240 - 360	100 - 150
Chipper	480	200
Supplemental Protection (Per Year)	7.68	3.20

lack of an adequate emission inventory or other suitable data makes it difficult to assess the impact of slash burning on the atmospheric environment. In general, however, it has been stated that greater emissions result from low temperature fires associated with broadcast burning.

Perhaps the most obvious concern about slash burning at this time is the reduction in visibility due to the smoke generation. This situation is especially severe in dry air where significant visibility reductions have been noted up to 40.25 km (25 miles) from a test fire and particulates have remained in the air for more than four hours after the major smoke emission.

Monitoring. As has been shown, recreation, logging, pesticides, spraying, and other Forest Service activities can result in environmental degradation. Surveillance of these activities is necessary in order to measure the effects and to ensure compliance with the applicable environmental standards. For water quality, the Forest Service Manual Title 2404.3 states that the Regional Forester and Supervisor will "Develop, approve and implement water quality plans to establish baseline water quality and provide surveillance of resource use, management and development." Presently, the Forest Service collects water quality data at approximately 70 sites. However, bacteriological, chemical and physical data are collected intermittently at these sites. The Washington Department of Ecology, U. S. Geological Survey and the Environmental Protection

Agency also have several water quality monitoring stations on streams flowing from Snoqualmie National Forest. Data collected from these streams includes chemical, bacteriological and physical parameters. A total surveillance network uniting Forest Service, Environmental Protection Agency, Department of Ecology and the U. S. Geological Survey programs to monitor activities on SNF has not been developed.

Unroaded Areas. Approximately 40% of the total area in SNF meets the criteria of further consideration for preservation in a natural state, e.g., unroaded areas 2,050 ha (5,000 acres) in size or larger. Public hearings held during 1972 in Oregon and Washington by the Forest Service, Region 6, indicated that of these 199,944 ha (487,670 acres), approximately 70% were generally supported for wilderness study, 6% not supported, and 15% questionable. The Chief of the Forest Service will make the decisions on areas to be chosen for wilderness study in January, 1973.

Mining

Mining on National Forest land has been environmentally devastating since the formation of the early mining laws. Legally, all Forest Service land is open to mining entry except campgrounds, roads, administrative sites, and a few specialized areas. A mine claim need only be staked out as either a placer or load claim, registered with the county, and have a minimum of $200 expended in the claim each year.

By law, the miner has the right of access to his claim, but must consider Forest Service interests. He can use any timber on the claim for his own personal use but may not sell it. If the mine proves to be profitable, the claim owner can have it patented and withdraw the land in his own name, or mine it as an unpatended claim.

The Forest Service is not automatically notified when a mine claim is staked out. They learn of new claims through observation or by checking with county records. Also, there are only a few instances in which the Forest Service can exercise some control on the operation. If it is suspected there is not enough mineral present to mine economically, or if the owner does not perform the required inprovements on the claim, then the Forest Service can contest the validity of the claim to the Bureau of Land Management, who administers the mining law. If the owner cannot prove he is complying with the law, then the claim is withdrawn. In another

case, if any Forest Service land adjacent to the claim is needed for mine tailing, buildings, or roads, then a special use permit is required. Through this permit, the Forest Service can make certain requirements; however, these must be reasonable and normally not involve the mining operation. As a result, the usual Forest Service involvement in mining is through cooperation with the State on safety, health and environmental regulations, and interest in placement of buildings and mine tailing. They have little control over where mine claims can be staked.

Presently, there are no active mines on SNF, however, two exploratory sites have potential for becoming active. They are Bren Mac Mine and the Middle Fork Mine.

The Bren Mac Mine is located in Sultan Basin near Vespers Peak and is at the headwaters of the Everett municipal watershed. Minerals present are copper, molybedium, tungsten, gold and silver. Presently, the owners are fulfilling Forest Service requirements to activate the mine into full production. Although the mine is patented, some of the tailings ponds will be on Forest Service land and a special use permit will be required. According to the SNF personnel, before the permit is issued, an environmental impact statement will be prepared and circulated. The Middle Fork Mine is located on the Middle Fork of Snoqualmie River on Hardscrabble Creek. The minerals present are copper, molybedium, and silver. The mine is still in an exploratory stage; however, the owners have applied for a special use permit to construct a road to the claim.

Grazing

Grazing on SNF is rather limited and occurs on the Naches and Tieton Ranger Districts only. There are approximately 700 head of cattle, 1500 head of sheep, and 500 horses grazing on 38,540 ha (94,000 acres) of Forest Service land. The grazing season extends from July 15 to September 15. Animals kept in the area after this time cannot be grazed on Forest Service land. These operations are also administered under the special use permit and therefore are subject to all requirements in the permit.

Special Environmental Problems

This section covers those activities which are either involved with both of the preceding sections or not included in either. The topics include those environmental problems associated with pesticides, municipal watersheds, administrative sites, and oil and hazardous materials.

Pesticides

Pesticides are used for six purposes: conifer release, right-of-way maintenance, range revegetation and noxious weed control, insect control, resident and campground weed control, and scrap fish control. Estimated FY 1973 uses by chemical and purpose are given in Table 6. Review and approval for Forest Service pesticide programs come from either the President's Council on Environmental Quality (CEQ) working group on Pesticides or the Forest Service Regional Office in Portland. The CEQ working group reviews all uses for (a) specified chemicals, (b) any pesticide applied to an area greater than 41 ha (100 acres), (c) non-registered uses, and (d) any application to water. The Forest Service Regional Office approves all other pesticide activities.

The pesticide user is divided into two groups: Forest Service and special use permittee. Except for domestic activities, actual application of SNF-sponsored uses are normally contracted to a private firm which also usually supplies the pesticide. A Forest Service employee who has a State Public Pesticide Operator License

TABLE 6

ESTIMATED FISCAL YEAR 1973 PESTICIDE USE
ON SNOQUALMIE NATIONAL FOREST

USE	CHEMICAL	AMOUNT Kg	(lb)
Conifer Release	2, 4-D Amine	1.8	(4)
	2, 4-D L.V. ester	0.9	(2)
	Picloram	3.6	(8)
	2, 4, 5-T ester	0.9	(2)
	2, 4-D (Tordon 101)	1.8	(4)
Right of Way Maintenance	2, 4-D L.V. ester	16.3	(36)
	Atrazine	13	(29)
	Simazine	13	(29)
	2, 4, 5-T amine	25.4	(56)
	amitrole	39	(86)
	bromacil	49	(108)
	2, 4-D	44	(96)
	2, 4-D amine	38	(84)
Range Revegetation and Noxious Weed Control	2, 4-D amine	10.4	(23)
Insect Control	Purina fly bait	.05	(0.12)
	Malathion	3.8	(8.3)
Forest Service Residence and Camp-groung weed control	2, 4-D amine	4.5	(10)
Scrap Fish Control	Rotenone	11.3	(25)

monitors SNF operations to ensure that the chemicals are applied in an acceptable manner. Pesticides used under the special use permit are applied by a contractor or the special use permittee and are not monitored by SNF.

Forest Service pesticides are stored at North Bend and Naches Ranger District headquarters. At North Bend, the chemicals are stored in a wire cage on the second floor of a wooden warehouse. At Naches, pesticides are stored in a wooden building in a small wood box. Included in this pesticide volume is 19 L (5 gal) of DDT which is being stored until acceptable disposal methods are developed. Signs are placed at both locations to denote pesticide storage. Waste pesticide containers are disposed of at the Cedar Falls landfill in King County.

For non-Forest Service uses, the SNF contracts and special use permits state that contractors and permittees must store and dispose of pesticides in compliance with State regulations. These regulations for pesticide storage are satisfactory; however, disposal sites have not yet been designated by the State.

There is no water quality monitoring of pesticide applications. Also, contingency plans for handling spills or emergency situations were not evident at the district level.

Municipal Watersheds

Thirteen municipalities obtain drinking water from areas partially or wholly within SNF boundaries (Table 7). Forest

TABLE 7

MUNICIPAL SUPPLY WATERSHEDS

MUNICIPALITY	DRAINAGE AREA	APPROXIMATE NUMBER OF ha	(acres)	PERCENT ON F.S. LAND
Everett	Sultan River Drainage	24,600	(60,000)	30%
Seattle	Lower South Fork of the Tolt River	3,975	(9,696)	33%
Bering	Small Drainage North of Bering	123	(300)	100%
Grofte	Small Drainage North of Grofte	262	(640)	100%
Timberlane Village	Anthracite Creek	164	(400)	100%
Scenic	Small Drainage South of Scenic	492	(1,200)	100%
Seattle	Cedar River Watershed	32,538	(9,360)	25%
Tacoma	Green River Watershed	60,680	(148,000)	33%
Buckley	East Fork of South Prairie	4,391	(10,710)	70%
Yakima	Naches and Tieton	215,418	(525,412)	100%
Lester	Lester Creek	1,558	(3,800)	50%
Index	Junction of North & South Fork of Skykomish	31	(75)	82%
Skykomish	Maloney Creek	1,522	(3,714)	70%

Service Manual Paragraph 2543.03 requires a municipal supply watershed management plan for each watershed when quality is a prime consideration. In view of the minimal treatment provided by each of the thirteen municipalities, quality is definitely a prime consideration and a management plan is therefore required for each watershed. To date, thirteen management plans have been developed and formal agreements have been established with three municipalities. These agreements provide that all activity within the watershed is subject to approval by the municipality. According to Forest Service Manual 2543, maps for public distribution should have municipality watersheds identified. None of the maps observed had such identification.

Administrative Sites

There are five administrative sites using septic tanks and drainfields for sewage disposal. On two of these, the Naches and Tieton District Headquarters, the systems are inadequate. Presently, SNF has sent to their regional office a request for funds to construct new facilities at these locations. At the North Bend District Headquarters, it is believed that the water table is high, allowing direct contact with the drainfield. Abatement procedures have been identified; however, the decision as to which, if any, of these problems get corrected depends on the amount of money allocated.

Oil and Hazardous Materials

Oil and hazardous material use on Forest Service land is limited to road oiling, pesticide spraying, gas for equipment and dynamite. In perspective, the amount used is quite small; however, an oil spill or an oil truck tipping over in a stream could have serious consequences. There is also little knowledge of the effect of runoff from road oiling on aquatic environment. Very little oil, gas, pesticides, or explosives are stored on SNF. A complete inventory of how much material present was not obtained because the volume fluctuates such that it would be almost meaningless. However, there are no storage containers greater than 189 L (50 gal) for any oil or gas near waterways.

There was no apparent contingency plan present at the district level to handle oil or hazardous material spills. While the chance for such a spill occurring is remote, the district personnel should be aware of the contingency plan.

APPENDIX

LEGEND OF TABLE "IMPROVED CAMPGROUNDS AND PICNIC GROUNDS"

FACILITIES AVAILABLE

BL - Boat Launching
CK - Community Kitchen
FT - Flush Toilet
GP - Group Picnic
PW - Piped Water
W - Well with Hand Pump
X - No trailer camping recommended because of rough and narrow access road
$ - Charge area under Land & Water Conservation Fund Act

THINGS TO DO (Activities Available)

B - Boating
BP - Berry Picking
F - Fishing
G - Geological
H - Hunting
Hi - Hiking
Hist - Historical
L - Lake
MC - Mountain Climbing
NT - Nature Trail
R - Riding
S - Swimming
Sc - Scenery
St - Stream
WS - Water Sports

IMPROVED CAMPGROUNDS AND PICNIC GROUNDS

Name	Size (Units) Tent Sites	Trailer Sites	Picnic Sites	Facilities and Things to Do
American Forks	20	6	9	CK,F,H,St,W
Asahel Curtis Picnic Grounds	-	-	26	F,H,Hi,NT,St,W
Beckler River	8	-	-	F,St
Big Creek	22	8	-	$,F,H,Hi,PW,St
Boulder Cave	22	-	-	CK,F,G,H,Hi,St
Bumping Lake Public Boat Landing	4	42	-	B,F,H,L,Sc,WS
Bumping Crossing	7	-	-	B,H,F,St
Bumping Lake	31	-	-	B,F,H,L,WS
Cedar Springs	14	-	4	$,F,H,St
Clear Lake	60	13	7	F,H,L
Clear Lake Boat Landing	6	-	-	BL,F,H,L
Cora Lake	3	-	-	F,H,Hi,L,Sc
Corral Pass	12	x	-	BP,H,Hi,R,Sc
Cottonwood	14	1	-	$,F,H,St,W
Cougar Flat	2	6	5	$,F,H,Hi,St,W
County Boat Landing	4	-	-	B,BL,F,Hi,L
Crane Park	6	-	-	F,Hi,L,WS
Crow Creek	4	-	-	F,H,Hi,St
Deception Falls Picnic Ground	-	-	4	F,Hi,St
Deep Creek	6	-	-	H,Hi,R,St
Denny Creek	45	-	5	F,G,GP,H,Hi,Hist,St,W
Dog Lake	10	x	-	B,BL,F,H,Hi,L
Dry Creek Picnic Ground	-	-	6	F,H,Hi
East Point	3	-	3	F,Hi,L,WS
Foss River	5	-	-	F,Hi,St
Granite Lake	9	-	-	B,F,H,Hi,L,Sc
Grey Creek	5	x	-	F,H,Hi,St
Halfway Flat	12	-	-	F,H,St
Hause Creek	49	11	-	$,F,H,Hi,PW,St
Hells Crossing	12	5	5	$,F,H,St,W
Huckleberry	8	-	-	BP,H,Sc
Indian Creek	45	9	-	$,F,H,L,PW,St
Indian Flat	8	-	-	F,H,St
Kaner Flat	34	11	49	$,F,H,Hi,Hist,St,W
Little Naches	17	-	-	F,H,St

IMPROVED CAMPGROUNDS AND PICNIC GROUNDS (CONT'D)

Name	Size (Units) Tent Sites	Trailer Sites	Picnic Sites	Facilities and Things to Do
Lodgepole	22	7	4	$,F,H,St
Lonesome Cove	4	-	1	F,L,WS
Lost Lake	6	-	-	F,Hi,L
McDaniel Lake	3	-	-	B,F,H,Hi
Money Creek	17	-	6	$,F,H,PW,St
Morning Glory	-	-	14	FT,Sc
Morse Creek	8	x	-	F,H,Hi,St
Pine Needle	6	x	-	F,H,St
Pleasant Valley	6	-	-	CK,F,H,Hi,St
Rimrock Public Boat Landing	4	-	-	B,BL,F,L,WS
River Bend	6	x	-	$,F,PW,St
Russell Creek	-	-	5	F,L,WS
San Juan	12	-	-	F,St
Sawmill Flat	3	16	19	$,F,H,SH,St,W
Section 3 Lake	2	x	1	H,Hi,MC,R,Sc
Silver Salmon Cove	-	x	4	F,H,WS
Silver Springs	16	34	10	$,BP,CK,F,H,Hi, PW,R,Sc
Soda Springs	20	-	-	CK,F,G,H,Hi,St
South Fork	11	-	-	F,H,St
South Fork Bay	4	-	-	B,F,H,Hi,L,St,WS
Taylor River	21	x	-	F,H,Hi,MC,St
The Dalles	19	26	11	$,BP,CK,F,H,Hi, NT,St,Sc
Troublesome Creek	27	-	-	F,Hi,R
Twin Camps	3	x	2	BP,H,Hi,PW,R,Sc
Tye Canyon	2	x	-	F,Hi,St
Upper Bumping Lake	4	x	-	H,Hi,R
West Fork Miller River	4	x	-	F,St
White Pass Lake	20	-	-	B,BL,F,H,R
Wild Rose	7	-	4	$,F,H,St,W
Willows	16	-	-	$,F,H,St,W
Windy Point	15	4	-	$,F,H,St,W

WATER SUPPLY FACILITIES - SNOQUALMIE NATIONAL FOREST
NACHES AND TIETON RANGER DISTRICTS

Location	Observations
Silver Springs	The well is located in a pit and is equipped with a submersible pump. A split cover is provided for the pit. Recommend a solid, overlapping cover with security lock. A 37,800 L (10,000 gal) fir construction reservoir rides on the system and appears satisfactory. Recommend a check of access to tank through old water level recorder inlet hole. Hole should be plugged if access to possible contamination is found. System distribution in the campground previously consisted of a loop to an island in the river. Water to the island is now cut off with two dead ends into the river. The river has cut back the bank so that valve boxes are submerged during periods of high water.
Hells Crossing*	Hand pump, concrete slab, seals on pump and between pump casing and slab are in good condition. All hand pump installations are identical construction with concrete slabs around the casing. Forest Service specifications also call for bentonite seal from the surface to a depth of at least 4.5 m (18 feet) or 1.5 m (5 feet) into an impervious strata. Pit toilets located 22.5 (75) - 37.5 m (125 feet) upstream from well. Driller well log indicates blue clay layer at depths 3 (10) - 8.4 m (28 feet) and water bearing strata at 8.4 (28) - 10 m (33 feet) depth. High iron and manganese -- 0.67 and 0.22 mg/l respectively.
American Forks*	Hand pump, seals satisfactory. Pit toilets previously located 7.5 (25) - 10 m (33 feet) away have been removed. Water bearing strata, 17.4 (58) - 23 m (77 feet) depth. Iron = 3.7 mg/l, Manganese = 0.24 mg/l, Zinc = 7.3 mg/l. Very strong hydrogen sulfide odor noted.

Location	Observations
Cougar Flat*	Hand pump, seals satisfactory, no apparent nearby contamination. Water bearing strata 14 (47) - 15.6 m (52 feet) depth. Iron and Manganese - 0.50 and 0.06 mg/l.
Sawmill Flat*	Hand pump, concrete cracked around pump base. Water bearing strata 10.5 (35) - 12 m (40 feet) depth. Iron and Manganese - 0.49 and 0.08 mg/l.
Cottonwood	Hand pump, seals satisfactory. Water bearing strata 12.3 (41) - 12.8 m (46 feet) depth.
Kaner Flat	Hand pump, seals satisfactory, no apparent nearby contamination. Water bearing strata 20 (65) - 21 m (70 feet) depth, Hardpan 7.5 (25) - 9.8 m (32 feet) depth. Iron and Manganese - 0.16 and 0.00 mg/l.
Indian Creek*	Pressure system, submersible pump located in well house, drainage satisfactory. Hole for possible access of contamination noted in top plate of pump. Time did not permit inspection of the storage reservoir which rides on the system. Reservoir reported to be similar in construction to other pressure systems which were satisfactory. Iron and Manganese -- 0.11 and 0.07 mg/l.
Hause Creek	Well #1. Submersible pump located in well house. Chemical feed equipment for iron and manganese control. Power to building turned off, well not in use, Seal on top of well needs repair. Floor drain from building allows water to enter building rather than providing drainage. Well #2. Pump located in well house along with chemical feed equipment and pressure sand filter for iron and manganese control. Oil leaking from the chemical feed pump had contaminated the day tank with oil observed floating on chemical solution and coating the interior of the tank. A rat's nest and excreta were also observed on top of the day tank. Holes in

Location	Observations
Hause Creek (Cont'd)	the tank cover for access of the chemical feed line provided a potential for contamination of the solution with animal excreta. Raw water iron and manganese - 1.0 and 0.26 mg/l. Hause Creek Reservoir is wood construction, 189,000 L (50,000 gal) tank. Access hole for old water level guage should be closed. Security lock on access cover is also needed.
Wild Rose	Hand pump, seals satisfactory, no apparent nearby contamination. Water bearing strata 10.8 (36) - 12 m (40 feet) depth. High iron and manganese.
Willows*	Hand pump, seals satisfactory, no apparent nearby contamination. Gravel formation 7.8 (26) - 10 m (33 feet) depth with basalt to 45 m (150 feet). Iron and manganese - 2.2 and 0.05 mg/l.
Windy Point	Hand pump seals satisfactory, no apparent nearby contamination.

* Water supplies in which one or both chemicals exceed PHS Water Supply Standards.

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